IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT(s):	Sonti, et al.	CONF. NO.:	3267
SERIAL NO.:	10/802,141	ART UNIT:	1742
FILING DATE:	03/17/2004	EXAMINER:	Kessler, Christopher S.
TITLE:	METHOD AND APPARATUS FOR STRENGTHENING OF POWDER METAL GEARS BY AUSFORMING		
ATTORNEY DOCKET NO.:	215P011709-US (PAR)		

Declaration Under 37 C.F.R. 1.132

I, Dr. Nagesh Sonti being as listed an inventor in the subject patent application do hereby state that:

1. I, Nagesh Sonti, have over nineteen years of experience in the design and production of gears. In addition, I have over thirty three years of experience in thermal-mechanical processing of steels, including heat treatment, joining, machining and finishing of steel components. I am presently a Research Engineer at the Applied Research Lab at Pennsylvania State University. I have a Ph.D. in Engineering Science and Mechanics from Pennsylvania State University, a Masters degree in welding engineering from Ohio State University and a Bachelors degree in mechanical engineering from the University of Madras, India.

2. Research was performed by Applied Research Lab at Pennsylvania State University to try and improve the performance characteristics of powder metal gears.

3. Surface durability tests were conducted at the Applied Research Lab at Pennsylvania State University to compare the pitting fatigue and wear resistance of wrought steel gears; powder metal forged (fully densified) steel gears; and the ausformed powder metal forged steel gears formed by the methods claimed in this patent application.

As a result of the tests the ausformed powder metal forged gears formed by the methods claimed in the present application showed:

about a 100% higher pitting fatigue G-50 life as compared to wrought steel gears and

a pitting fatigue G-50 life of over ten times higher than powder metal forged steel gears that had not been ausformed.

4. Scoring tests performed on the ausformed powder metal forged gears formed by the methods claimed in the present application also showed vast improvements over wrought steel and unausformed powder metal gears. The scoring tests showed that the scoring resistance (as measured by scoring temperature at equivalent loads and speeds) of the ausformed powder metal gears formed by the methods claimed in the present application increased by about 30°F as compared to wrought steel gears and increased by over 60°F as compared to unausformed powder metal gears.

5. Bending fatigue tests were also performed on the ausformed powder metal gears formed by the methods claimed in the present application as compared to wrought steel and unausformed powder metal gears. During this test the ausformed powder metal gears showed about a 15% increase in bending fatigue strength over the unausformed powder metal gears. It is noted that the ausformed

powder metal gears formed by the methods of the present application exhibited improved surface durability and scoring resistance while maintaining equivalent bending fatigue strength as compared to wrought steel gears.

6. Tooth impact test results were performed on the ausformed powder metal gears formed by the methods claimed in the present application. The ausformed powder metal gears were able to absorb more impact energy than wrought steel gears which is an another aspect not achievable with conventional powder metal gears.

7. The unexpectedly better performance of ausformed powder metal steel gears over conventional powder metal gears can be attributed to the enhanced accuracy and surface finish of ausformed powder metal gears created by the powder metal gear tooth finishing surface of the dies claimed in the methods of the present application, as well as increased strength due to ausforming effects of Applicant's methods.

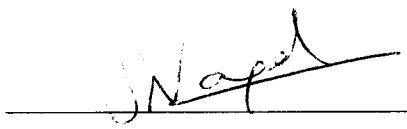
8. In addition to the unexpectedly better performance characteristics of the ausformed powder metal gears formed by the methods claimed in the present application as described above a cost analysis was performed by the Applied Research Lab to compare ausformed powder metal steel gears as produced by the method claimed in the present application and conventional wrought steel gears. It is noted that the cost analysis was performed for the wrought steel gears as these gears may be replaced by the ausformed powder metal gears formed by the methods of the present application as conventional powder metal gears do not possess the desired performance characteristics to replace the wrought steel gears.

The cost analysis showed that the manufacturing cost per piece to produce ausformed powder metal steel gears according to the methods claimed by Applicant was over 43% lower than the manufacturing cost per piece to produce conventional wrought steel gears of equivalent quality. Thus, forming a powder metal ausformed gear according to the methods claimed by Applicant shows a significant cost savings over a wrought steel gear having equivalent performance characteristics.

9. The die designs criteria with respect to forming wrought steel gears, powder metal gears and the ausformed powder metal gears formed by the methods of Applicant's claims are drastically different. Dies to form wrought steel gears are designed to plastically deform the surface layers of the gear blank without any volume change of the workpiece. The depth of the surface deformation when forming a wrought steel gear is less than about 0.0015 inches per flank (tooth thickness reduction is about 0.003 inches) where the die has to impart high lateral loads (and be able to withstand substantial elastic deflections of the gear/die teeth) to induce plastic deformation in the tooth surface. A die for forming a powder metal gear such as that disclosed in Cole is designed to densify the soft steel surface layers of the powder metal workpiece. No plastic deformation is performed by the dies in Cole and there are low elastic deflections of gear/die teeth as compared to the dies used for forming wrought steel gears. The tooth thickness reduction produced by the die in Cole is up to about 0.010 inches. The die of Cole is also only designed for pre-finishing operations prior to heat treating the workpiece (i.e. subsequent grinding or other finishing is needed to finish shaping the gear teeth). The powder metal gear tooth finishing surface of the die claimed in Applicant's claims is designed to plastically

deform and densify the surface of the gear teeth to form a tooth having a finished geometrical shape where no subsequent shaping is needed. The die in Applicant's claim is designed to create a tooth thickness reduction of about 0.006 inches.

And, further, that all statements made herein based on our knowledge are true and that all statements made on information and belief are believed to be true, and that we are aware that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001), and may jeopardize the validity of this application, document, or patent issuing therefrom.



Dated: March 3, 2008

Dr. Nagesh Sonti